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G2J J33BX

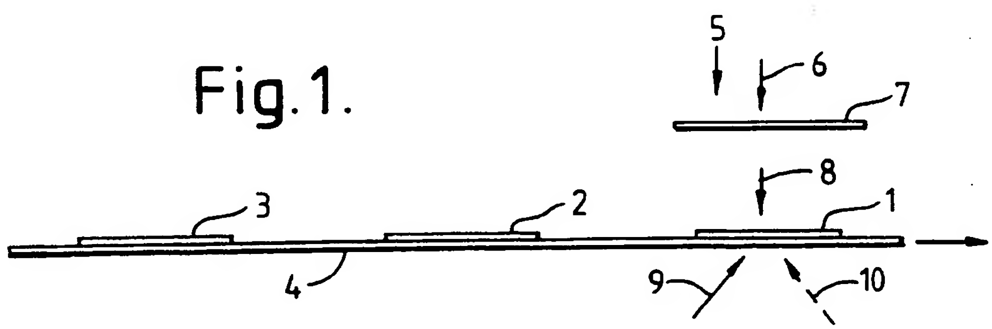
(56) Documents cited
GB 2133574 A GB 1567693 A GB 1139955 A
US 4209250 A US 3612640 A

(58) Field of search
UK CL (Edition K) G2J J33BX
INT CL^5 G03B, G03C, G03H

(54) **Producing security holograms**

(57) In a process for the mass production of holograms for security purposes, regions (1, 2, 3...) of a photosensitive material are fed in turn through an exposure position (5) at which a respective unique hologram is formed in each region by interference between a reference coherent light beam (9) and a coherent light beam (8) bearing an image. The image is partially or wholly changed for each successive region, and may be carried by an updatable display, such as a liquid crystal display.

Fig.1.



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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Fig. 1.

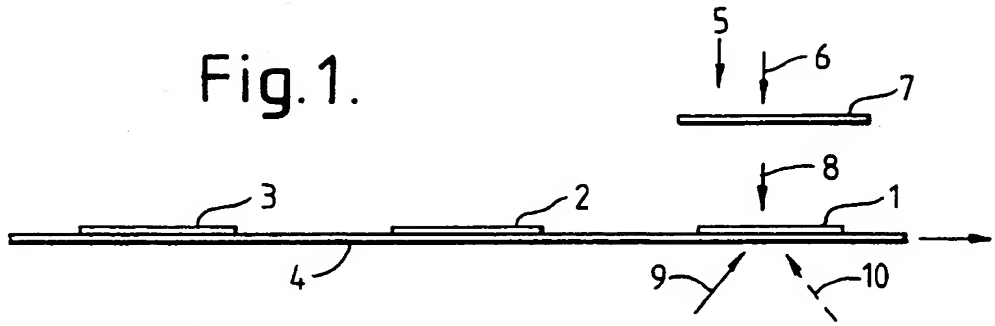


Fig. 2.

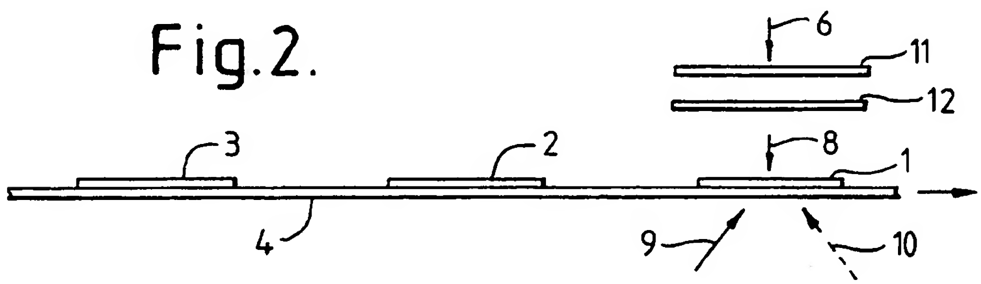


Fig. 3.

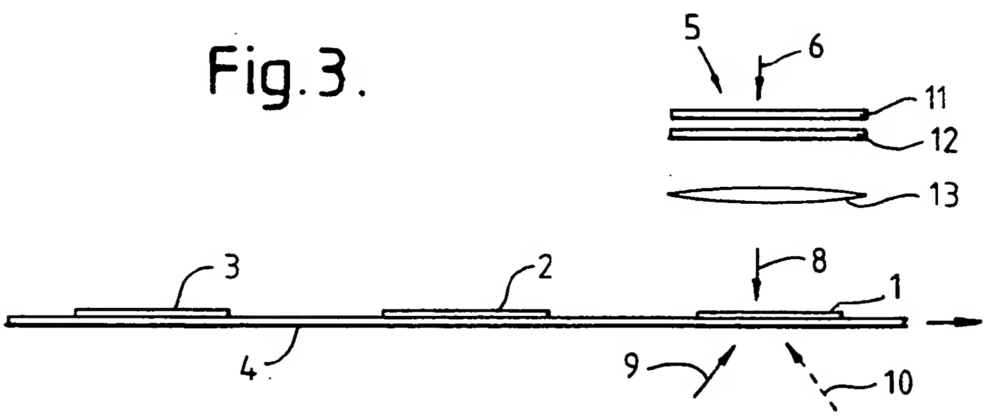


Fig. 4.

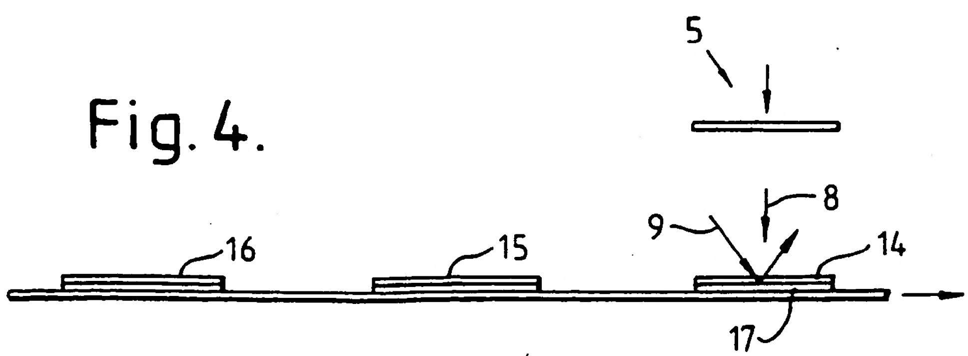


Fig. 5.

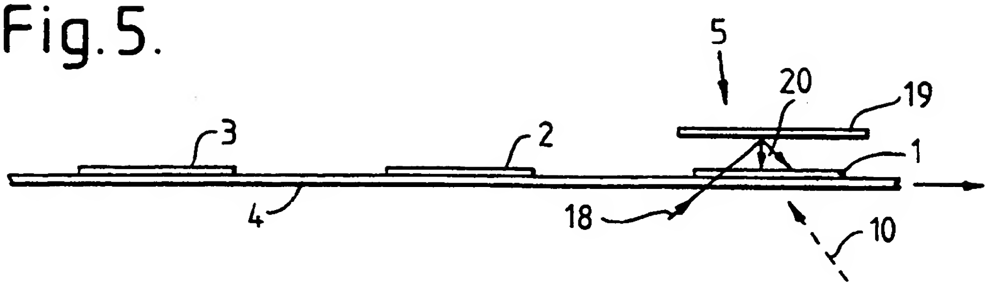


Fig. 6.

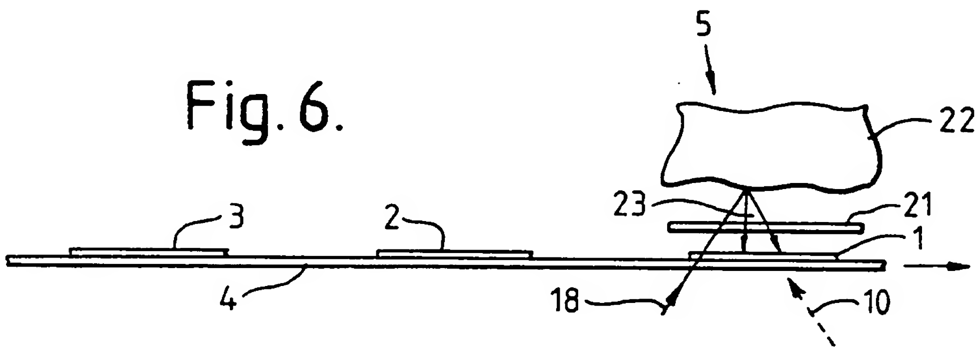


Fig. 7.

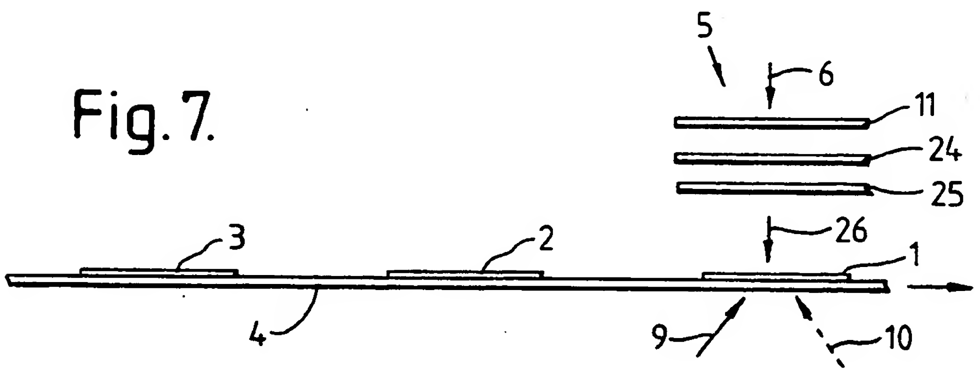
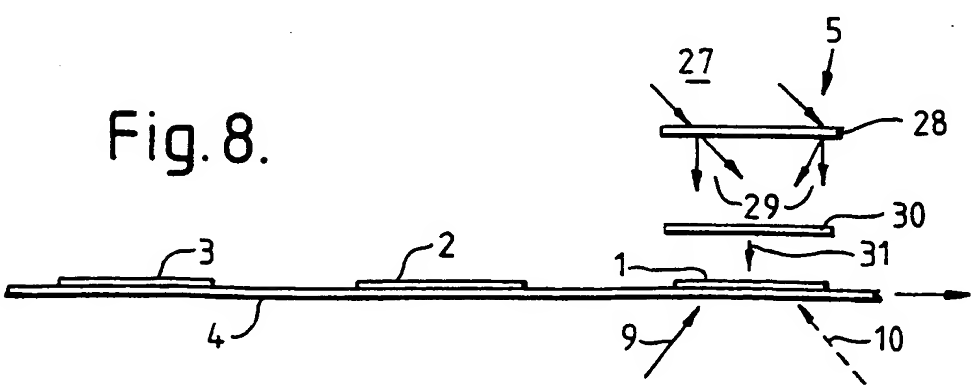


Fig. 8.



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Holograms

This invention relates to the mass production of holograms for security purposes.

In some known security systems, for example as used on some credit cards and bank cards and for secure labelling of products, holograms are used for authentication purposes and to discourage counterfeiting of, and/or unauthorised tampering with, the cards, labels, etc. The holograms for such purposes are generally mass-produced by a process wherein, for example, a master surface-relief hologram of an object is produced, and this master is used to emboss reflection holograms into metal foil forming at least part of, or to be affixed to, the card, label etc. The production of the die bearing the master hologram can be time-consuming and expensive. Furthermore, all of the copy holograms produced by such a die are identical.

It is an object of the present invention to provide an improved process for producing holograms for security purposes.

According to the invention there is provided a process for producing security holograms, wherein regions of photosensitive material are fed in turn through an exposure station; and wherein at said station a respective unique hologram is formed in each region by interference between a reference coherent light beam and a coherent light beam bearing an image.

Embodiments of the invention will now be described, by way

of example, with reference to the accompanying drawings, in which

Figures 1-8 are schematic side views illustrating respective different methods of mass-producing security holograms in accordance with the invention.

Referring to Figure 1 of the drawings, in a first method of mass-producing security holograms, pieces 1,2,3,...of a high-resolution photosensitive medium, which may be applied to a transparent backing film (not shown), are fed in turn by a transparent conveyor 4 through an exposure station 5. At the exposure station a coherent light beam 6 is passed through a photographic slide 7, or other transparency, which carries an image from which the hologram is to be formed, so that an object beam 8 bearing the image impinges on the photosensitive medium 1. A reference coherent beam 9 is directed upwards through the conveyor 4 and through the photosensitive medium and interferes with the object beam 8, producing a holographic record on the medium. One or more additional reference coherent beams 10 may also be used, if required. The piece 1 of photosensitive medium is then moved onward from the exposure station 5 to a developing and fixing station (not shown) and the piece 2 is moved to the exposure station. The transparency 7 is then changed, so that the hologram produced on the piece 2 is different from that on piece 1.

Figure 2 shows an alternative method in which the coherent light 6 is passed through a diffuser 11 and then through an updatable transmissive display 12, such as liquid crystal display. Due to the ability to update the display, the hologram is of an arbitrary nature. It is changed, from piece to piece of the photosensitive medium, by addressing the cells of the display 12 differently for each exposure so that each hologram is unique. As in Figure 1, the reference coherent beam 9, and the beam 10 if required, are directed upwards through the conveyor 4 and on to the photosensitive material.

In Figure 3 a lens 13 is located between the display 12 (or a transparency in place of the display) and the photosensitive material, so that data items on the display or transparency are focused on to, or near, the plane of the material, and a clear

holographic record of the items is thereby produced. Again, the items are changed from piece to piece of photosensitive material by changing the addressing of the display cells or by using a different transparency for each piece.

In the embodiment of Figure 4 the photosensitive material 14,15,16 is associated with a reflective backing layer 17. The layer 17 may be attached to the material or may form part of the conveyor 4. The reference beam 9 is directed on to the material from above, passes through the material a first time, is reflected by the backing layer 17, passes a second time through the photosensitive material and emerges therefrom. The object beam 8 interferes with the reference beam during its first pass through the material, thereby forming a transmission hologram. It also interferes during the second pass, and a second interference grating is superimposed on the first and is viewable as a reflection hologram. Whereas the embodiments of Figures 1-3 require the use of a transparent conveyor to allow access to the underside of the photosensitive material, the method of the present embodiment can be effected entirely from the front side of the material. An opaque conveyer 4 can therefore be used, and the production of the hologram can, if required, be carried out after the photosensitive material has been affixed to a product, if the reflective backing layer 17 is attached to the photosensitive material. The object beam 8 can be produced by any of the previously-described methods.

Referring to Figure 5, in another method of forming a hologram a single coherent beam 18 passes upwards through the transparent conveyor 4 and through the photosensitive material 1. The beam is reflected from a reflective diffusing updatable display 19, such as a reflective liquid crystal display, and returns to the photosensitive material as the object beam 20. The beam 20 interferes with the input beam 18 and the required hologram is thereby produced. The single coherent input beam therefore provides both the reference beam and the object beam. This method is based on the so-called Denisyuk (or Lippmann) hologram.

Figure 6 shows an embodiment similar to that of Figure 5, but in which the single coherent reference beam 18 passes through

the conveyor 4 and the photosensitive material 1 and then through an updatable transmissive (e.g. liquid crystal) display 21. It is then reflected from an object 22, so that the object beam 23 carries both the updatable information from the display 21 and fixed information from the object 22.

Figure 7 shows another embodiment in which the reference beam 9 passes through the conveyor 4 and into the photosensitive material 1. A coherent beam 6 passes through a diffuser 11, through a static transmissive display 24 and through an updatable display 25 to produce an object beam 26. This interferes with the beam 9 to produce the required holographic recording on the material 1.

In the embodiment of Figure 8 a coherent beam 27 is passed through a pre-existing master hologram 28. The resulting beam 29 is passed through an updatable (e.g. liquid crystal) display 30 to produce an object beam 31. This interferes with the reference beam 9 (and the beam 10, if used) to produce the output hologram at the photosensitive material 1.

A number of modifications can be made to the embodiments described above. For example, in the embodiments of Figures 2 and 3 the positions of the diffuser 11 and the display 12 can be interchanged. Likewise, in Figure 7 the diffuser 11 may alternatively be positioned beneath the displays 24 and 25 or between them. Although the conveyor 4 has been described as transparent, it would alternatively be possible to use an opaque conveyor with apertures therein of substantially the same dimensions as the pieces of photosensitive material.

At the exposure station 5 the light source or sources for exposing the photosensitive material may produce continuous light for the whole of the exposure period. If that is the case, the pieces 1,2,3... of photosensitive material must be moved into place at the exposure station by the conveyor and then held stationary during the exposure period. Alternatively, the light source(s) may be pulsed. If the pulses are sufficiently short, the conveyor may move the photosensitive material continuously during exposure. Instead of feeding separate pieces of photosensitive material to the exposure station, a continuous web of material might be used, the

web being fed to a guillotine (not shown) for cutting it into pieces, each bearing a unique hologram.

The photosensitive material may be any of a number of types, including silver halide emulsion, a photopolymer material, a liquid crystal polymer or a photochromic material. The material might be sensitised for recording at the wavelength of the light source(s) by inclusion of, for example, an absorbing dye therein. The material could be deposited directly on the product, credit card, etc., which is to be marked, or might be deposited on a suitable substrate material. Deposition of the photosensitive material may be effected by, for example, dipping the substrate into a liquid form of the photoconductive material, by spin coating the substrate or by screen printing.

The images to be used in the production of the holograms may be provided in any of a number of forms, some of which are described above. For example, each image may be provided on a transparency, such as a photographic slide, or an updatable transmissive display, such as a liquid crystal display or a spatial light modulator; in the form of an updatable reflecting two-dimensional device, such as a photographic print, a reflecting display (e.g. a liquid-crystal display) or a reflecting spatial light modulator; in the form of a three-dimensional object; or in the form of one or more pre-existing holograms.

It will be apparent that, by use of an updatable display as described above, or by a simple image-changing operation such as substituting a different transparency for each successive exposure, each hologram is unique or quasi-unique. The apparatus can be made to effect this changing of the hologram automatically as each hologram is produced. Each product, credit card, etc. bearing such hologram is, therefore, "fingerprinted", which lends authenticity to it and makes counterfeiting more difficult. The holographic nature of the label, etc., would be more discouraging to potential counterfeiters than would a normally-printed image. Furthermore, by use of a readily updatable display for producing the image, variable data items, such as batch numbers, incremented serial numbers, owner codes, sell-by dates, etc., can be readily

incorporated in the holograms. This holographic recording will clearly provide added security for the recorded data.

Each hologram thus produced is usable by itself on a product, credit card, etc. as a security device, i.e. only one such hologram per article is needed.

Claims

1. A process for producing security holograms, wherein regions of photosensitive material are fed in turn through an exposure station; and wherein at said station a respective unique hologram is formed in each region by interference between a reference coherent light beam and a coherent light beam bearing an image.

2. A process as claimed in Claim 1, wherein for each region said image is carried by, or is modified by, an updatable display.

3. A process as claimed in Claim 2, wherein the updatable display comprises a liquid crystal display.

4. A process as claimed in Claim 2, wherein the updatable display comprises a spatial light modulator.

5. A process as claimed in any preceding claim, wherein for each region the image is carried by a respective transparency.

6. A process as claimed in any one of Claims 1-4, wherein for each region the image is carried by a respective photographic print.

7. A process as claimed in any one of Claims 1-4, wherein for each region the image is in the form of a respective hologram.

8. A process as claimed in any one of Claims 1-4, wherein for each region the image is derived from a three-dimensional object.

9. A process as claimed in any preceding claim, wherein the photosensitive material is light-transmissive; and wherein the image-bearing light beam and the reference light beam are directed at the photosensitive material from opposite faces of the material.

10. A process as claimed in any one of Claims 1-8, wherein the photosensitive material is light-transmissive; and wherein the image-bearing light beam is produced by reflection of the reference beam after the reference beam has passed through the photosensitive material.

11. A process as claimed in any one of Claims 1-8, wherein the photosensitive material has a reflective backing associated therewith; wherein the reference light beam makes a first pass through the photosensitive material, is reflected by the reflective backing and makes a second pass back through the photosensitive material; and wherein the image-bearing light beam interferes with

the reference light beam both on said first pass and on said second pass through the photosensitive material, thereby forming a reflection hologram.

12. A process as claimed in any preceding claim, wherein changing of the image is effected automatically as the regions are fed to the exposure station.

13. A process as claimed in any preceding claim, wherein the photosensitive material comprises a silver halide emulsion.

14. A process as claimed in any one of Claims 1-12, wherein the photosensitive material comprises a photopolymer material.

15. A process as claimed in any one of Claims 1-12, wherein the photosensitive material comprises a liquid crystal polymer.

16. A process as claimed in any one of Claims 1-12, wherein the photosensitive material comprises a photochromic material.

17. A process as claimed in any one of Claims 13-16, wherein the photosensitive material contains a dye selected for improved operation at the wavelength of the reference and image-bearing light beams.

18. A process for producing holograms, substantially as hereinbefore described with reference to the accompanying drawings.

19. A process for marking a plurality of articles, wherein a respective hologram produced by a process as claimed in any one of Claims 1-18 is attached to each said article.

Patents Act 1977
Examiner's report to the Comptroller under Se .on 17 (The Search Report)

Application number 9205579.7

Relevant Technical fields

(i) UK Cl (Edition K) G2J (J33BX)

(ii) Int CL (Edition 5) G03H, G03B, G03C

Search Examiner

M K B REYNOLDS

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search

18 JUNE 1992

Documents considered relevant following a search in respect of claims 1-19

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2133574 A (APPLIED HOLOGRAPHICS) Figures, page 2 lines 2-69	1, 5-10, 13-16, 19
X	GB 1567693 (MATSUSHITA) Figures	1, 5-10, 13-16, 19
X	GB 1139955 (RCA) Figures especially figure 4	1, 5-10, 13-16, 19
X	US 4209250 (JAMES) Figures	1, 5-10, 13-16, 19
X	US 3612640 (BELL) Figures	1, 5-10, 13-16, 19

Category	Identity of document and relevant passages	Relevant to claim(s)

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